

REINFORCED CONCRETE DRILL PIPE

Technical field

The invention relates to a concrete drill pipe for drilling systems in special foundation engineering.

5 **Prior art**

Drill pipes for drilling systems in special foundation engineering are usually made of steel or another metal and are pulled up again already during or after the drill hole has been filled with concrete and reused. Such drill pipes are described, for example, in DE20008887U1. However, it is also possible to use drill pipes that remain in the ground after the drill hole has been filled. Such
10 drill pipes are also called lost drill pipes and are described, for example, in US10648146B1. KR101847906B1 discloses a composite pipe body which is mainly inserted into the ground to cast a pile and consists of a retaining pipe made of precast concrete elements and a retrieval pipe made of steel. When the composite pipe body reaches a certain depth, the retrieval pipe is pulled out and retrieved, and concrete is poured into the retaining pipe to complete the pile. CN216809867U
15 describes a double-walled pipe body with an inner side made of steel and an outer side made of concrete, which is used as a drill pipe.

The known drill pipes have several disadvantages. In the case of the steel drill pipes that are mostly used, a reinforcing iron is inserted into the drill hole to reinforce the concrete pile before the drill hole is filled with concrete in order to obtain sufficiently stable concrete piles. In addition,
20 the steel pipes must be pulled back up out of the drill hole again after the drill hole has been filled with concrete. When pulling up the pile, there is a risk of the fresh concrete pile becoming constricted, wherein a layer of soil in the drill hole collapses and mixes with the filled concrete, preventing the concrete pile from being continuous. The use of reinforcing iron and the pulling up and cleaning of the drill pipe used involves additional expenditure in terms of both time and
25 materials.

The well-known lost drill pipes are often not stable enough. For stabilization, some of the drill rods and bits are left in the ground, serving as a replacement for reinforcement. In the case of lost

drill pipes, in which one layer is made entirely of steel, there is a risk of corrosion of the steel pipes. In addition, the concrete of the concrete pile in the steel pipe does not bond with the soil outside the steel pipe. This results in less skin friction and the concrete piles are then less stable. Likewise, with a continuous steel pipe, a lot of material remains in the ground and does not decompose.

5 The known solutions therefore either require additional reinforcement to produce sufficiently stable concrete piles, or they require a lot of material that is “lost” in the ground. In addition, such drill pipes are very heavy. The known solutions are therefore neither economically nor ecologically efficient, are time-consuming in the production of the concrete piles, and have a high material consumption.

10 **Object of the invention**

The present invention is based on the object of creating a stable drill pipe which can be left in the ground, which requires little material, and with which stable concrete piles can be produced without additional reinforcement and with little expenditure of time, thus saving time and material.

15 **Description of the invention**

15 This object is achieved by a reinforced drill pipe for supporting drill holes for the production of concrete piles or anchors, wherein the drill pipe has a top end and an upper connecting piece arranged at the top end and a base end and a lower connecting piece arranged at the base end, wherein the drill pipe has at least one outer pipe made of concrete and at least one inner pipe arranged therein and made of a metal material or of an abrasion-resistant plastic, and wherein the
20 drill pipe has a central section between the upper connecting piece and the lower connecting piece. The inner pipe made of a metallic material or of an abrasion-resistant plastic has a plurality of recesses with the same cross-sectional area in the central section, wherein the central section with the recesses extends over at least one quarter of the total length of the drill pipe and over a maximum of seven-eighths of the total length of the drill pipe.

25 The advantage of such a reinforced drill pipe with an outer pipe made of concrete and an inner pipe made of a metallic material or an abrasion-resistant plastic is that the drill pipe serves as a drill pipe, as reinforcement and as a concrete casing at the same time. This means that no additional

reinforcement is required to produce the concrete pile. Such a reinforced drill pipe according to the invention is also referred to as a reinforced concrete drill pipe. The drill pipe is left in the ground and does not need to be pulled out of the ground after the drill hole has been filled with concrete. On the one hand, the recesses in the central section of the drill pipe can save material. On the other
5 hand, the recesses in the central section are filled with concrete during the manufacture of the drill pipe when the inner pipe is encased in the outer pipe made of concrete. Despite the recesses in the inner pipe, the drill pipe is therefore very stable. If the drill hole drilled with the drill pipe is filled with concrete after the soil material has been removed, the liquid concrete filled into the drill hole comes into contact with the concrete casing of the outer pipe. This creates a force-fitting connection
10 between the concrete core and the outer pipe, resulting in a very stable concrete pile.

The central section with the recesses is located between the upper and lower connecting pieces of the top and base ends of the drill pipe. The upper connecting piece is located at the top end of the drill pipe and the lower connecting piece is located at the base end of the drill pipe and both belong to the drill pipe. The top end with the upper connecting piece is understood to be the end
15 of the drill pipe which, when the drill pipe is inserted into a drill hole, is at the upper end of the drill pipe above the base end and the central section. The base end with the lower connecting piece is understood to be the end of the drill pipe which, when the drill pipe is inserted into a drill hole, is at the lower end of the drill pipe beneath the top end and the central section. The casing wall of the inner pipe of the upper and lower connecting piece is preferably made entirely of a metallic
20 material or an abrasion-resistant plastic and has a closed casing wall and no recesses. However, it is possible for the upper connecting piece at the top end of the drill pipe to have two to four openings at the same height to accommodate fastening devices, such as bolts, for fastening the drill pipe arranged above, which is screwed or inserted into the drill pipe below.

The central section extends over at least one quarter and a maximum of seven eighths of the
25 total length of the drill pipe, preferably over a maximum of three quarters, more preferably over a maximum of two thirds of the total length of the drill pipe. Particularly preferably, the central section with the recesses extends over at least one third and at most over two thirds of the total

length of the drill pipe, particularly preferably over half of the total length of the drill pipe. Such drill pipes are particularly stable and at the same time have a high number of recesses to save material. The total length of the drill pipe is understood to be the entire length between the top end and the base end of the drill pipe in the longitudinal direction of the pipe. In a preferred
5 embodiment, the central section with the recesses extends completely over the region between the upper and lower connecting piece and has a continuous plurality of recesses in the casing wall of the inner pipe located at the same distance. In a further embodiment, the central section has a plurality of sections with a plurality of recesses and sections in between in the longitudinal direction without recesses.

10 The drill pipes preferably have a length of 1 to 10 meters, more preferably 1 to 6 meters, and have an inner diameter of preferably 10 to 300 cm, more preferably 100 to 250 cm. The wall thickness of the inner steel pipe is preferably 2 mm to 15 cm, more preferably 3 cm to 10 cm and the wall thickness of the outer pipe is preferably 7 mm to 20 cm, more preferably 7 cm to 12 cm.

A plurality of recesses, also called multiple recesses, with the same cross-sectional area in the
15 central section is understood to mean that the casing wall of the inner pipe has a plurality of openings or holes in the central section, wherein each recess, or each opening or hole in the casing wall has the same cross-sectional area. The term plurality means at least ten, preferably at least 100 recesses. The plurality of recesses in the central section are preferably arranged evenly distributed relative to one another over the lateral surface of the central section of the inner pipe. By arranged
20 evenly distributed relative to one another it is meant that the distance between the individual recesses is the same everywhere, and they are thus distributed evenly and at the same distance over a surface.

The recesses preferably have a diameter of 4 mm to 10 cm, more preferably 0.5 cm to 5 cm, depending on the size of the aggregates of the concrete. Preferably, the recesses have a diameter
25 which is larger than the diameter of the aggregates of the concrete so that the concrete can flow into the recesses and fill the recesses with concrete. Preferably, the central section has one to thirty, preferably three to thirty, recesses on an area of 10x10 cm. Preferably, the wall thickness of the

edges between the recesses or the distance of the closed surface between the recesses is the same. Preferably, the central section with the recesses has a mesh structure or a grid or lattice structure, in which the recesses are present as open cells between the solid edges formed from the casing wall of the inner pipe. The central section consists predominantly of open recesses and the diameter of the recesses or openings or cells is at least twice, preferably at least three times, even more preferably at least four times as large as the diameter of the edges or the distance between the recesses. The wall thickness of the edges between the recesses is at most half, preferably at most a quarter of the diameter of the cross-sectional area of the recesses. The mesh structure is particularly preferred.

The cross-sectional area of the recesses or the cross-section of the holes or openings in the central section is preferably round, oval or polygonal, preferably triangular to octagonal. In a particularly preferred embodiment, the cross-sectional area of the recess is hexagonal and the central section has a hexagonal mesh structure. The advantage of a hexagonal mesh structure is that it achieves the greatest possible stability with the least possible material. This means that the central section has a predominantly open structure with a hexagonal mesh structure, the wall thickness of the edges around the recesses and the material consumption are kept low, and yet a high level of stability is achieved in the central section. Compared to conventional drill pipes, the hexagonal mesh structure results in particularly stable drill pipes with particularly low material consumption.

The reinforced drill pipe has at least one outer pipe made of concrete and at least one inner pipe made of a metallic material or an abrasion-resistant plastic and is preferably a double-walled drill pipe. In addition to the outer pipe and the inner pipe, the drill pipe may have further pipe layers and thus further casing walls, for example to reinforce or protect the outer pipe or the inner pipe, and is then referred to as a multi-walled drill pipe. For example, within the inner pipe made of a metallic material or an abrasion-resistant plastic, an additional inner pipe made of concrete can be arranged, such that the inner pipe made of a metallic material or an abrasion-resistant plastic is arranged between two concrete pipes in a sandwich-like structure.

The outer concrete pipe is preferably made of normal concrete or ultra-high-performance concrete, preferably as a precast component. The outer concrete pipe can be manufactured, for example, by formwork or by centrifugal casting. Formwork is intended to be the mold into which fresh concrete is poured to produce concrete molded parts. It is usually removed after the concrete has hardened. The formwork is the corresponding hollow form for the concrete part. In the centrifugal casting process, concrete pipes are manufactured by rapidly rotating a pipe mold filled with concrete around its longitudinal axis. During rotation, the concrete is thrown against the wall of the mold due to centrifugal force and thus compacted. Part of the mixing water is separated inwards, so that a favorable water-cement ratio is created. In the centrifugal casting process, for example, the inner pipe according to the invention made of a metallic material or of an abrasion-resistant plastic can be inserted into a pipe mold, the pipe mold is then filled with concrete, and by rotating the pipe mold around the longitudinal axis, the concrete is thrown onto the wall inside and outside the inner pipe, thereby creating a reinforced concrete drilling pipe with an outer pipe made of concrete, an inner pipe made of a metallic material or abrasion-resistant plastic and an innermost layer, inside the inner pipe, made of concrete.

A particularly preferred outer pipe made of concrete additionally comprises fibers for reinforcing the concrete, preferably basalt fibers, steel fibers or glass-ceramic fibers. Particularly preferred is concrete reinforced with basalt fibers, the so-called basalt fiber reinforced concrete.

A particularly stable drill pipe can be achieved by making the inner pipe from a metallic material or an abrasion-resistant plastic. An inner pipe made of a metallic material is preferred. The metallic material used can be, for example, hard metal, steel, chrome steel, iron or aluminum. An inner pipe made of steel is particularly preferred. Examples of abrasion-resistant plastics that can be used are hard plastics, glass fiber reinforced plastics, or carbon fiber reinforced plastics, also known as carbon. The inner pipe with the upper connecting piece, the central section and the lower connecting piece is preferably manufactured in one piece.

Both the outer pipe and the inner pipe preferably have a round cross-section throughout. Preferably, the outer pipe made of concrete completely encloses the inner pipe with the recesses in

the central section, and the inner pipe is arranged concentrically within the outer pipe, wherein in the central section the recesses of the inner pipe can be filled with concrete from the outer pipe, so that in the central section the outer pipe can be arranged between the edges surrounding the recesses in addition to the casing of the inner pipe and the inner pipe thus also has a closed surface.

5 Preferably, the outer concrete pipe encloses the inner pipe over the entire length of the drill pipe with the exception of the connecting piece, which is respectively inserted into an adjacent connecting piece. This end region of the drill pipe with a connecting piece which can be inserted into an adjacent connecting piece does not have an outer pipe and is therefore formed only from the material of the inner pipe. Preferably, the inner pipe is arranged in a form-fitting manner within
10 the outer pipe and the outer pipe made of concrete is cast directly around the inner pipe. The inner pipe can also be integrally connected to the outer pipe, for example by gluing the inner pipe and the outer pipe together, preferably using a polymer adhesive, for example a two-component adhesive. This improves the mechanical properties of the drill pipe, such as torsional stiffness.

To produce the reinforced drill pipe, the outer pipe is either cast from concrete as a preform, or
15 manufactured using formwork or centrifugal casting, and the inner pipe made of a metallic material or an abrasion-resistant plastic is inserted into the preform made of concrete. In this case, the recesses of the inner pipe remain open and are filled with concrete when the drill hole is filled. In a preferred production process, the outer pipe is cast from concrete around the inner pipe and the recesses in the central section of the inner pipe are filled with concrete during the production of
20 the drill pipe, thus producing a particularly stable drill pipe. In this case, the reinforced concrete drill pipe also has a closed surface on the inside of the inner pipe.

In a preferred embodiment, to produce the reinforced drill pipe, half-shells of the reinforced drill pipe are first produced. This has the great advantage that the half-shells can be stacked on top of each other and transported easily and in a space-saving manner. On site, two half-shells are
25 joined together to form a pipe and used as a reinforced drill pipe. To produce the half-shells for the reinforced drill pipe, the outer pipe is cast from concrete as a half-shell using formwork or centrifugal casting. The inner pipe made of a metallic material or an abrasion-resistant plastic is

also manufactured as a half-shell and placed in the half-shell of the outer pipe made of concrete or, preferably, the half-shell of the outer pipe made of concrete is cast directly around the half-shell of the inner pipe. The half-shells each have two longitudinal folds, also called longitudinal joints, on the long edges, which are offset from each other so that they fit together in a form-fitting manner when joined together. Preferably, the longitudinal folds are fastened to each other using rivets or screws through holes in the longitudinal fold.

In a further embodiment, the outer pipe has filter openings at least in the central section, wherein the filter openings are radially spaced such that the filter openings serve as a filter for a filter well drill pipe. Depending on the length required for filtration, the outer pipe has filter openings over only part of the central section up to the entire length of the drill pipe. Preferably, the filter openings are arranged continuously throughout the entire reinforced drill pipe, so that the inner pipe and, if applicable, other inner layers also have filter openings. The filter openings are preferably in the form of slots or holes. Slots are particularly preferred as filter openings. Preferably, the slots have a length of 1 to 5 cm and a width of 2 to 5 mm. The filter openings are preferably evenly distributed and arranged in rows offset from one another. The filter openings can be created, for example, using high-pressure water jets or milling in the outer concrete pipe or in the entire drill pipe. In a preferred embodiment, the filter openings are arranged substantially at the same height as the recesses in the central section of the inner pipe. The filter openings can also be arranged only partially in the central section and do not have to be distributed over the entire central section. It is only important that if the filter openings of the outer pipe are not arranged at the same height as the recesses in the inner pipe immediately below, the filter openings must be continuous through the entire drill pipe so that when the reinforced drill pipe is used as a filter well drill pipe, the water to be filtered passes through the filter openings of the outer pipe and through the recesses or filter openings of the inner pipe into the interior of the drill pipe. In a filter well drill pipe, the inner pipe is preferably made of chrome steel. This is particularly preferred when drinking water is to be filtered.

The upper connecting piece and the lower connecting piece are used to connect several drill

pipes to each other, or to connect the drill pipe to a drive device or to a drilling or cutting head. Preferably, the connecting pieces have a coupling structure such that the upper connecting piece at the top end of a first drill pipe can be connected in a form-fitting manner in the longitudinal direction of the drill pipe to a lower connecting piece at the base end of a second drill pipe connected thereabove. The coupling structure is respectively arranged in the end region of the respective connecting piece and has, for example, a threaded connection, a flange or a toothing. In the case of a threaded connection with a rotary coupling, the top end and the base end of the drill pipes have a rotary coupling half and two drill pipes are screwed together in a form-fitting manner in the longitudinal direction of the drill pipes by adjoining each other at the ends and then rotating them relative to each other by a rotation angle of the two rotary coupling halves. In the case of a flange or a toothing, two drill pipes are inserted into one another by inserting the lower connecting piece at the base end of a first drill pipe in the longitudinal direction of the drill pipe into an upper connecting piece at the top end of a second drill pipe connected below it, wherein the upper and lower connecting pieces are designed to be complementary to one another in such a way that a form-fitting connection is achieved. The connecting piece which is respectively inserted into an adjacent connecting piece does not have a respective outer pipe in the end region of the drill pipe and is therefore formed only from the material of the inner pipe. Multiple drill pipes connected together are also called an extended drill pipe or drill string. The drill string consists of multiple drill pipes and has the length of the desired drill hole or concrete pile.

In one embodiment, the lower connecting piece at the base end of the drill pipe has a drill bit for drilling the drill pipe into a subsurface. Preferably, the respective lowest drill pipe of the drill string, also called the base pipe, has a drill bit at the base end. The base pipe with a drill bit at the base end preferably has no coupling structure at the lower connecting piece. The drill bit can, for example, have a toothing with teeth, a cutting structure or reinforcement with abrasive particles, for example diamond particles. The drill pipe is suitable for drilling into various types of soil. Examples of the soil include cohesive soils such as loam, clay, marl or silt, or non-cohesive soils such as sand, gravel, scree or rock.

The invention also relates to the use of the reinforced drill pipe as a side wall of a concrete pile or anchor, wherein the inner pipe made of a metallic material or of an abrasion-resistant plastic, preferably of steel, serves as reinforcement.

Furthermore, the invention relates to a method for producing a concrete pile or an anchor,
5 comprising the following steps:

(A) screwing a first reinforced drill pipe according to the invention, preferably with a drill bit at the base end, into a subsoil and removing the subsoil from the drill pipe to form a drill hole;

(B) form-fittingly connecting the lower connecting piece of a further drill pipe according to the invention with the upper connecting piece of the first drill pipe below;

10 (C) repeating steps (A) and (B) until the desired drilling depth is reached;

(D) leaving this extended drill pipe in the drill hole; and subsequently

(E) filling the drill hole with concrete and allowing the concrete to harden in the drill pipes.

The reinforced drill pipes according to the invention can be used for the production of bored piles, concrete piles and anchors of all kinds in both large and small drill holes. The use of these
15 drill pipes and of the method according to the invention for the production of in-situ concrete piles is particularly preferred. But micropiles or anchors can also be produced therewith.

Well-known methods for producing bored piles or concrete piles are the Kelly drilling method, in which, however, separate reinforcing bars are inserted into the drill holes after drilling to reinforce the concrete piles and the drill pipes are pulled up in the drill holes before the concrete
20 hardens. The method according to the invention can be carried out in a similar way to the Kelly drilling method with the difference that no reinforcing bars are required and that the drill pipes are left in the drill hole before and after filling the drill hole and are not pulled up. In this way, on the one hand, the material of the reinforcements can be saved and at the same time a lot of time can be saved because there is no need to unload the reinforcement and install it separately, no need to pull
25 back the drill pipes, no need to clean, load, transport and repair the drill pipes and thus less fuel consumption. In addition, concreting the bored pile is simplified because only the core of the concrete pile needs to be concreted and no additional material is required due to the gap that would

be created by pulling up the drill pipe. In addition, with conventional methods, there is a risk of soil extraction or constriction in soft soil when pulling up the drill pipe. This risk does not exist in the method according to the invention because the drill pipe remains in the drill hole, which means that no ultrasonic pipes are required for testing, which also saves time. All these advantages mean
5 that the construction site duration can be halved or even shortened. This leads to lower fuel consumption, less wear and tear, and is overall more environmentally friendly. Thus, the reinforced drill pipe according to the invention provides a stable drill pipe which can save time and money and which is therefore economically and ecologically sensible.

Combinations of two or more of the above embodiments and variants are conceivable and
10 claimed.

Further advantages of the invention will become apparent from the following description, in which the invention is explained in more detail based on exemplary embodiments shown in the drawings.

Brief description of the figures

15 In particular:

Fig. 1A shows a schematic perspective view of a reinforced drill pipe with drill bit, with the outer pipe partially removed,

Fig. 1B shows a cross-section through the upper connecting piece of a drill pipe with coupling structure,

20 Fig. 2A shows a longitudinal section through the drill pipe of Fig. 1A with the outer pipe partially removed,

Fig. 2B shows a schematic view of a drill pipe of Fig. 1A on the outside of the drill pipe with the outer pipe partially removed,

25 Fig. 3 shows a perspective view of a reinforced drill pipe of Fig. 1A with a continuous outer pipe,

Fig. 4A shows a schematic perspective view of a reinforced drill pipe with coupling structure on the upper and lower connecting piece,

Fig. 4B shows a schematic perspective view of a reinforced drill pipe with coupling structure on the upper and lower connecting piece made of half-shells,

Fig. 5A shows a cross-section through the upper connecting piece of a drill pipe made of two half-shells,

5 Fig. 5B shows a section of Fig. 5A with the cross-section through the corresponding joints of the two half-shells,

Fig. 6A shows a schematic perspective view of a half-shell of the drill pipe shown in Fig. 4B,

10 Fig. 6B shows a cross-section through the upper connecting piece of the drill pipe in Fig. 6A, and

Fig. 7 shows a schematic perspective view of a filter well drill pipe.

In the figures, the same reference symbols are used for the same elements and explanations of a specific reference symbol apply to all figures unless expressly stated otherwise.

Exemplary embodiments of the invention

15 Fig. 1A shows a schematic perspective view of a reinforced, here double-walled, drill pipe 1 with an inner pipe 3 made of steel and an outer pipe 4 made of concrete and a drill bit 11 at the base end 6 of the drill pipe 1. Such a drill pipe 1 is also called a base pipe and is used as the first and lowest drill pipe when drilling a drill hole into a subsoil. The drill bit 11 has teeth 15 for drilling into the subsoil, is made entirely of steel and can additionally be reinforced with abrasive particles, 20 for example diamond particles. The drill pipe 1 or base pipe shown here has a top end 4 and an upper connecting piece 5 arranged at the top end with a coupling structure 12 in the form of a tothing, wherein the coupling structure 12 with the tothing is arranged in the upper region, preferably in the upper half of the upper connecting piece 5. The tothing is arranged on the inner side of the inner pipe and serves to receive a complementary tothing of a drill pipe arranged above 25 it (shown in Fig. 4), which has a coupling structure in the form of a tothing on the outer side of the inner pipe of the lower connecting piece at the base end of the drill pipe. The upper connecting piece 5 has four openings 13 in the region of the coupling structure 12 for receiving bolts (not

shown), which serve to fasten the drill pipes inserted into one another (not shown). The upper connecting piece 5 extends to the central section 8 with the recesses 10, wherein the upper connecting piece 5 has a closed inner pipe 3 and a closed outer pipe 2 with the exception of the openings 13. In the view shown in Fig. 1A, the outer pipe 2 is removed in the region of the central section 8 to provide a better view of the inner pipe 3 in the central section 8. In reality, the outer pipe 2 made of concrete completely encloses the inner pipe 3 from the top end 4 to the base end 6. The outer pipe 3 preferably has a wall thickness of 7 to 12 cm.

The inner pipe 3 is preferably made of steel and has a plurality of recesses 10 with the same cross-sectional area in the central section between the upper connecting piece 5 and the lower connecting piece 7 in the casing wall. The inner pipe 3 preferably has a wall thickness of about 3 to 6 cm. The central section 8 with the recesses 10 extends over at least a quarter of the total length of the drill pipe 1, preferably over at least half of the total length of the drill pipe 1. In the embodiment shown in Fig. 1A, the central section 8 extends over half of the total length of the drill pipe, and the upper section 5 and the lower section each extend over a quarter of the total length of the drill pipe 1. The lower connecting piece 7 does not have a coupling structure, but is formed by a continuous inner pipe 3 made of steel and a continuous outer pipe 2 made of concrete, with a drill bit 11 made of steel at the end of the lower connecting piece 7 of the drill pipe 1.

The central section 8 has multiple, preferably at least 100, recesses 10 in the casing wall of the inner pipe 3 at equal intervals. The recesses 10 in the central section 8 are arranged evenly and at equal distances from one another over the lateral surface of the central section 8 of the inner pipe 3, and the cross-sectional area of the recesses 10 preferably has a diameter of 1 cm to 10 cm. The recesses 10 are enclosed by edges 14. The wall thickness of the edges 14 between the recesses 10 is the same everywhere and amounts to at most half, preferably at most one fifth of the diameter of the cross-sectional area of the recesses 10. The evenly distributed recesses 10 have a grid structure in which the recesses are present as open cells between the solid edges 14, which are formed from the casing wall of the inner pipe 3. The cross-sectional area of the recesses 10 is hexagonal and the grid structure is a hexagonal mesh structure 9. The advantage of a hexagonal

mesh structure 9 is that the greatest possible stability is achieved with the least possible material.

Fig. 1B shows a cross-section through the upper connecting piece 5 of the drill pipe 1 with the coupling structure 12. The outer pipe 2 is visible, which encloses the inner pipe 3 with the coupling structure 12.

Fig. 2A shows a longitudinal section through the drill pipe 1, or base pipe, as described in Fig. 1A, with the outer pipe partially removed. The central section 8 of the inner pipe 3 with the hexagonal mesh structure 9, the recesses 10 and the edges 14 between the recesses 10 extends over half of the drill pipe 1. Above and below the central section 8, the upper connecting piece 5 with the coupling structure 12 is arranged on the inner side of the upper connecting piece 5 and the lower connecting piece 7 with a drill bit 11 is arranged at the lower end of the lower connecting piece 7. The upper connecting piece 5 and the lower connecting piece 7 each extend over approximately one quarter of the total length of the drill pipe 1. The coupling structure 12 with the toothing extends over the upper half of the upper connecting piece 5.

Fig. 2B shows a side view of a drill pipe 1 as described in Fig. 1A, with the outer pipe 2 partially removed.

Fig. 3 shows a perspective view of a reinforced drill pipe 1, as described in Fig. 1A, but with the outer pipe 2 shown continuously. The outer pipe 2 completely encloses the inner pipe 3. During the production of the drill pipe 1, the mold part for the outer pipe 2 made of concrete is cast around the inner pipe 3 made of steel and the concrete flows into the open recesses 10 (not shown). As a result, the recesses are filled with concrete and a stable drill pipe 1 with integrated reinforcement, a so-called reinforced concrete drill pipe, is achieved.

Fig. 4A is a schematic perspective view of a reinforced drill pipe 1' as described in Fig. 1A, with the difference that the drill pipe 1' does not have a drill bit and that, in addition to the coupling structure 12 on the upper connecting piece 5, it has a coupling structure 12' on the lower connecting piece 7 instead of the drill bit. The coupling structure 12' on the lower connecting piece 7 is arranged on the outside of the inner pipe 3 made of steel and extends over the lower half of the lower connecting piece 7. The coupling structure 12' has a complementary shape to the coupling

structure at the upper end of the upper connecting piece 5, such that the upper connecting piece 5 at the top end 4 of a first drill pipe 1 (shown in Fig. 1A) can be connected in a form-fitting manner in the longitudinal direction of the drill pipe to a lower connecting piece 7 at the base end 6 of a second drill pipe 1' adjoining thereabove. The coupling structure 12' of the lower connecting piece 12' of the upper drill pipe 1' is pushed into the coupling structure 12 of the upper connecting piece 5 of the underlying drill pipe 1.

The outer pipe 2 encloses the inner pipe 3 in a drill pipe 1' with an upper inner coupling structure 12 and a lower outer coupling structure 12' only up to the upper end of the lower coupling structure 12', such that the lower coupling structure 12' can be pushed completely into a drill pipe 1 (shown in Fig. 1A) connected there-below.

The drill pipe 1' has in the central section 8 the same recesses 10 as described in Fig. 1A. The recesses 10 are not visible in the illustration shown in Fig. 4 because the outer pipe 2 is shown as continuous. The curly brackets represent the regions of the upper connecting piece 5, of the central section 8 and of the lower connecting piece 7, which are described in Fig. 1A, with the difference that the lower connecting piece 7 does not have a drill bit as shown in Fig. 1A, but a lower coupling structure 12'.

Fig. 4B shows a schematic perspective view of a reinforced drill pipe 1' as described in Fig. 4A, wherein the drill pipe 1' is made of two half-shells 16 (shown in Fig. 6A). The two half-shells 16 are connected to each other via two offset longitudinal folds (17). The two longitudinal folds (17) are placed on top of each other in a form-fitting manner and fastened to each other using rivets or screws. The rivets or screws are guided through pre-drilled holes (18) in the longitudinal fold (17).

Fig. 5A shows a cross-section through the upper connecting piece 5 of a drill pipe 1' as described in Fig. 4B. The drill pipe 1' consists of two half-shells 16, which are connected to each other via a longitudinal fold 17.

Fig. 5B shows a section of Fig. 5A with the cross-section through the corresponding longitudinal folds 17 of the two half-shells 16.

Fig. 6A shows a schematic perspective view of a half-shell 16 of the drill pipe 16 described in Fig. 4B. The half-shell 16 has a longitudinal fold 17 on each of the respective longitudinal edges, wherein the shape of the longitudinal folds 17 is offset from one another or opposite to one another, such that the longitudinal fold 17 of one half-shell 16 can be placed on top of a longitudinal fold 17 of the second half-shell 16 in a form-fitting manner and can be connected to one another via rivets or screws through drill holes 18,

Fig. 6B shows a cross-section through the half-shell 16 of the drill pipe 1' as described in Fig. 6A with the two longitudinal folds 17 opposite in shape to each other.

Fig. 7 shows a filter well drill pipe 20. The filter well drill pipe 20 is a drill pipe 1' as described in Fig. 4A, wherein the filter well drill pipe 20 additionally has filter openings 19 in the form of slots 21 in the central section 8. The slots 21 are arranged radially spaced. The distances between the individual slots 21 are evenly distributed and arranged in rows offset from one another. The filter openings 19 are arranged in the central section 8 essentially at the same height as the recesses 10 of the inner pipe 3 (shown in Figs. 1 and 2). They can also be arranged only partially in the central section 8 or over the entire drill pipe 1'. It is only important that when using the reinforced drill pipe as a filter well drill pipe, the water to be filtered passes through the filter openings of the outer pipe and through the recesses or filter openings of the inner pipe into the interior of the drill pipe.

List of reference numerals

	1, 1'	reinforced drill pipe
	2	outer pipe
	3	inner pipe
5	4	top end
	5	upper connecting piece
	6	base end
	7	lower connecting piece
	8	central section
10	9	mesh structure
	10	recess
	11	drill bit
	12, 12'	coupling structure
	13	opening
15	14	edge
	15	teeth
	16	half-shell
	17	longitudinal fold
	18	drill hole in longitudinal fold
20	19	filter opening
	20	filter well drill pipe
	21	slot

CLAIMS

1. A reinforced drill pipe (1, 1') for supporting drill holes for the production of concrete piles or anchors, with a top end (4) and an upper connecting piece (5) arranged at the top end (4) and with a base end (6) and a lower connecting piece (5) arranged at the base end (6), wherein the drill pipe (1, 1') has at least one outer pipe (2) made of concrete and at least one inner pipe (3) made of a metallic material or of an abrasion-resistant plastic arranged therein, wherein the drill pipe (1, 1') has a central section (8) between the upper connecting piece (5) and the lower connecting piece (7), characterized in that the inner pipe (3) made of steel has a plurality of recesses (10) with the same cross-sectional area in the central section (8) in the casing wall, the plurality comprising at least ten recesses (10), and wherein the central section (8) with the recesses (10) extends over at least one quarter of the total length of the drill pipe (1, 1') and extends over a maximum of seven-eighths of the total length of the drill pipe (1, 1').

2. The reinforced drill pipe (1, 1') according to claim 1, characterized in that the cross-sectional area of the recesses (10) is round, oval or polygonal.

3. The reinforced drill pipe (1, 1') according to claim 1 or 2, characterized in that the cross-sectional area of the recesses (10) is hexagonal and the central section (8) has a hexagonal mesh structure (9).

4. The reinforced drill pipe (1, 1') according to any one of the preceding claims, characterized in that the recesses (10) in the central section (8) are arranged evenly distributed over the outer surface of the inner pipe (3).

5. The reinforced drill pipe (1, 1') according to any one of the preceding claims, characterized in that the central section (8) with the recesses (10) extends over a maximum of two thirds of the total length of the drill pipe (1, 1').

6. The reinforced drill pipe (1, 1') according to any one of the preceding claims, characterized in that the recesses (10) in the central section (8) have a diameter of 4 mm to 10 cm.

7. The reinforced drill pipe (1, 1') according to any one of the preceding claims, characterized in that the central section (8) has three to thirty recesses (10) on an area of 10x10 cm.

8. The reinforced drill pipe (1, 1') according to any one of the preceding claims, characterized in that the central section (8) has multiple sections with a plurality of recesses (10) and sections without recesses in between.

5 9. The reinforced drill pipe (1, 1') according to any one of the preceding claims, characterized in that the drill pipe (1, 1') or the inner pipe (3) and the outer pipe (2) have a continuous round cross-section and the inner pipe (3) is arranged concentrically within the outer pipe (2).

10. The reinforced drill pipe (1, 1') according to any one of the preceding claims, characterized in that the inner pipe (3) is made of steel.

10 11. The reinforced drill pipe (1, 1') according to any one of the preceding claims, characterized in that the outer pipe (2) has filter openings (19) at least in the central section (8), the filter openings (19) being radially spaced such that the filter openings (19) serve as a filter for a filter well drill pipe (20).

15 12. The reinforced drill pipe (1, 1') according to any one of the preceding claims, characterized in that the upper connecting piece (5) and/or the lower connecting piece (7) have a coupling structure (12, 12') such that the upper connecting piece (5) at the top end (4) of a first drill pipe (1) can be connected in a form-fitting manner in the longitudinal direction of the drill pipe (1) to a lower connecting piece (7) at the base end (6) of a second drill pipe (1') adjoining thereabove.

20 13. The reinforced drill pipe (1, 1') according to any one of the preceding claims, characterized in that the lower connecting piece (7) at the base end (6) of the drill pipe (1) has a drill bit (11) for drilling the drill pipe (1) into a subsoil.

14. Use of a reinforced drill pipe (1, 1') according to any one of the preceding claims as a side wall of a concrete pile or anchor, wherein the inner pipe (3) made of a metallic material or of an abrasion-resistant plastic serves as reinforcement.

15. A method for producing a concrete pile or anchor, comprising the following steps:

25 (A) screwing a first reinforced drill pipe (1) according to any one of claims 1 to 13 into a subsoil and conveying the subsoil out of the drill pipe (1) to form a drill hole;

(B) form-fittingly connecting the lower connecting piece (7) of a further drill pipe (1')

according to any one of claims 1 to 11 with the upper connecting piece (5) of the first drill pipe (1);

(C) repeating steps (A) and (B) until the desired drilling depth is reached;

(D) leaving this extended drill pipe (1, 1') in the drill hole; and subsequently

5 (E) filling the drill hole with concrete and allowing the concrete to harden in the drill pipes (1, 1').