hole.

[0004]

However, the difference between the inner diameter of the casing and the outer diameter of the sleeve body is relatively small. Thus, in order to insert the sleeve body suspended by a crane into the casing along with the hammer and the hammer rod, accurate positioning is necessary. Accordingly, the insertion requires some time. Moreover, if unwanted obstacles such as crushed stones get in between upper wedge pieces and lower wedge pieces that press the liners, the liners cannot make the expanding and contrasting movement smoothly. Furthermore, if a hose connected to the hammer rod cannot be smoothly fed toward and pulled away from the casing according to the vertical movement of the hammer rod, troubles such as impeding the movement of the hammer rod and damaging the hose occur. Thus, there is still room for improvement to further improve workability to efficiently drill a vertical hole in hard ground.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0005]

Patent Document 1: Japanese patent application Kokai publication No. 2019-78123

SUMMARY

[0006]

This present disclosure provides a drilling system and drilling method capable of further improving workability to efficiently drill a vertical hole in hard ground.

[0007]

In one aspect, a drilling system according to the present disclosure is a drilling system including: a casing having a casing bit at a lower end portion thereof; a rotationally driving apparatus which holds an outer peripheral surface of this casing and rotationally drives the casing; a hammer having a hammer bit at a lower end portion thereof; a hammer rod to a lower end of which this hammer is attached and which is inserted in the casing; a weight and sleeve body inserted over the hammer rod inside the casing and restricted from rotating in a rod circumferential direction and being movable in a vertical direction; a liner placed on the weight or the sleeve body and being movable in a rod radial direction between an outer peripheral surface of the hammer rod and an inner peripheral surface of the casing; a mount portion which protrudes from an inner side of the casing and on which the sleeve body is mounted; an upper wedge piece protruding downward from the weight; a lower wedge piece placed on an inner side of the liner in the rod radial direction; and a hose connected to the hammer rod, the drilling system being such that the sleeve body is placed in a state of being suspended downward from the weight, the weight is suspendable from the hammer rod from an intermediate position on the hammer rod in the vertical direction, and as the weight moves downward relative to the sleeve body mounted on the mount portion, the upper wedge piece pushes the lower wedge piece, thereby making the liner move outward in the rod radial direction and press the inner peripheral surface of the casing, and in this state the casing is rotationally driven by the rotationally driving apparatus, so that the casing and the hammer are rotationally driven together, while a vertical striking force is applied to the

hammer with air supplied through the hose to thereby drill ground with the casing bit and the hammer bit, the drilling system characterized in that a plurality of the mount portions are disposed so as to be spaced in a circumferential direction of the casing, and the drilling system comprises: a plurality of insertion guides having an inclined portion protruding downward from a flange portion at a lower end of the sleeve body and inclined toward a tube axis of the sleeve body, and disposed on a peripheral edge portion of a lower end of the flange portion so as to be spaced in the circumferential direction; a wedge piece cover isolating the upper wedge piece and the lower wedge piece from an external space; and a hose holder suspended from a crane and holding the hose such that the hose is movable in a hose longitudinal direction.

[0008]

In another aspect, a drilling method according to the present disclosure is a drilling method including: inserting a hammer rod with a hammer attached to a lower end thereof into a casing, the hammer having a hammer bit at a lower end portion thereof, bringing a weight and sleeve body inserted over the hammer rod inside the casing into a state of being restricted from rotating in a rod circumferential direction and being movable in a vertical direction, placing a liner on the weight or the sleeve body, the liner being movable in a rod radial direction between an outer peripheral surface of the hammer rod and an inner peripheral surface of the casing, providing an upper wedge piece protruding downward from the weight and a lower wedge piece placed on an inner side of the liner in the rod radial direction, placing the sleeve body in a state of being suspended downward from the weight, rendering the weight

suspendable from the

hammer rod from an intermediate position on the hammer rod in the vertical direction, moving the weight downward relative to the sleeve body mounted on a mount portion protruding from an inner side of the casing to thereby make the upper wedge piece push the lower wedge piece, thereby making the liner move outward in the rod radial direction and press the inner peripheral surface of the casing, and rotationally driving the casing and the hammer together with a rotationally driving apparatus holding an outer peripheral surface of the casing while applying a vertical striking force to the hammer with air supplied through a hose connected to the hammer rod to thereby drill ground with a casing bit provided at a lower end portion of the casing and the hammer bit provided at the lower end portion of the hammer, the drilling method characterized in that it includes: disposing a plurality of the mount portions such that the mount portions are spaced in a circumferential direction of the casing; and designing a specification such that a plurality of insertion guides are disposed on a peripheral edge portion of a lower end of a flange portion at a lower end of the sleeve body so as to be spaced in the circumferential direction, each of the insertion guides having an inclined portion protruding downward from the flange portion and inclined toward a tube axis of the sleeve body; and drilling the ground with the upper wedge piece and the lower wedge piece isolated from an external space by a wedge piece cover and with the hose held so as to be movable in a hose longitudinal direction by a hose holder suspended from a crane.

[0009]

In one example, the hammer rod with the weight suspended thereon is moved downward to mount the

sleeve body on the mount portion protruding from the inner side of the casing, and the weight with the sleeve body suspended thereon is moved downward to make the liner move outward in the rod radial direction and press the inner peripheral surface of the casing via the upper wedge piece and the lower wedge piece. The hammer rod and the casing are integrated via this liner. Thus, by rotationally driving the casing and the hammer with the rotationally driving apparatus, a vertical hole can be drilled even in hard ground with the casing bit and the hammer bit. Moreover, by moving the hammer rod downward, the ground can be drilled deeper without adding another hammer rod. This is advantageous in efficiently drilling a vertical hole.

[0010]

In another example, the plurality of insertion guides are provided on the lower side of the flange portion at the lower end of the sleeve body. Thus, even when the difference between the inner diameter of the casing and the outer diameter of the sleeve body (flange portion) is small, the sleeve body (and the hammer and the hammer rod) can be smoothly inserted into the casing by bringing the insertion guides into abutment with the opening in the upper end of the casing. Moreover, the upper wedge piece and the lower wedge piece are isolated from the external space by the wedge piece cover. Thus, unwanted obstacles such as crushed stones are prevented from getting in between the upper wedge piece and the lower wedge piece. This makes it possible stably perform drilling work for a long period. In addition, the hose is held so as to be movable in the hose longitudinal direction by the hose holder suspended by a crane. In this way, the hose can be smoothly fed toward and pulled away from the casing according to the progress of drilling work.

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