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(54) **TUNNEL BORING MACHINE, TUNNEL BORING MACHINE CUTTER DISC AND CUTTER REPLACEMENT METHOD**

TUNNELBOHRMASCHINE, TUNNELBOHRMASCHINENFRÄSERSCHEIBE UND FRÄSERWECHSELVERFAHREN

TUNNELIER, DISQUE DE COUPE POUR TUNNELIER ET PROCÉDÉ DE REMPLACEMENT DE DISPOSITIF DE COUPE

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Description

[0001] This application claims the priority to Chinese Patent Application No. 201810707625.X, titled "TUNNEL BORING MACHINE, TUNNEL BORING MACHINE CUTTER DISC AND CUTTER REPLACEMENT METHOD", filed with the China National Intellectual Property Administration on July 02, 2018.

FIELD

[0002] The present application relates to the technical field of tunnel boring equipment, and in particular to a cutter head of a tunnel boring machine. In addition, the present application further relates to a tunnel boring machine including the above cutter head and a method for replacing cutters applied to the above cutter head.

BACKGROUND

[0003] A tunnel boring machine is a main tool used in underground tunnel boring engineering today. As one of the key components of the tunnel boring machine, the cutter head is mainly used to excavate the heading face of a tunnel. The cutter head is provided with cutters.

[0004] At present, in a case that the cutter is worn or damaged, the staff are required to enter the soil sump or the slurry sump to work. However, since the soil has not been reinforced, the strength and stability of the soil are insufficient, and there is a certain risk of collapse. Moreover, in a case that the buried depth of the tunnel boring machine is relatively large, the infiltration of groundwater also causes great inconvenience to the construction. Especially in the case of unstable and extremely harsh geology, the slurry sump needs to be pressurized to maintain the stability of the heading face of the tunnel, and the staff needs to work in a pressurized environment. It can be seen that the personal safety of the staff is difficult to guarantee during the operation of replacing the cutter.

[0005] Therefore, a technical issue to be addressed presently by those skilled in the art is to improve to the safety of replacing the cutter.

Among the prior arts, the patent of JPH0518184A discloses a tunnel connecting construction method, in the method, when a preceding shield machine reaches the connection point, a slurry hardening agent is injected into a cutter chamber, and various facilities in the shield are removed. The slurry hardening agent is injected into the cutter chamber of an approaching shield machine, and jet water is sprayed through a jet water spray nozzle to loosen the peripheral ground. Both penetration tooth bodies are engaged, a chemical is injected between rotary cutters, the natural ground sediment is hardened, and various facilities of the other shield machine are disassembled and removed. A freezing unit is operated to freeze the natural ground sediment around the connection section, the rotary cutters are disassembled and removed, the hardened soil and natural ground sediment are discharged, and reinforcing connecting plates are fitted. The patent of CN106522970A discloses a shield cutter head with a refrigeration function and a shield tunneling machine. The shield cutter head with the refrigeration function comprises a disc-shaped cutter head body composed of a plurality of spoke beams and a refrigeration pipeline arranged on the cutter head body. The spoke beams are composed of the multiple main spoke beams and the multiple secondary spoke beams which are distributed in a radial mode with the center of the cutter head body as the center and are arranged alternately. The inner ends of the secondary spoke beams are connected with the adjacent main spoke beams through a main ring beam, and the outer ends of the secondary spoke beams are connected with the outer ends of the adjacent main spoke beams through a ring beam. The back portions of the multiple main spoke beams and the secondary spoke beams are all provided with cooling liquid passages distributed in the length direction, and the cooling liquid passages formed in the back portions of the main spoke beams and the secondary spoke beams sequentially communicate according to the distribution mode of the main spoke beams and the secondary spoke beams to form the refrigeration pipeline.

SUMMARY

[0006] In view of this, an object of the present application is to provide a tunnel boring machine cutter head which can ensure safe replacement of the cutter. Another object of the present application is to provide a tunnel boring machine including the tunnel boring machine cutter head, the cutter of which can be replaced safely. Yet another object of the present application is to provide a method for replacing the cutter applied to the tunnel boring machine cutter head, according to which the cutter can be safely replaced.

[0007] In order to achieve the above objects, the following technical solutions are provided according to the present application.

[0008] A tunnel boring machine cutter head includes a cutter head body. The cutter head body is provided with mounting holes which penetrate through the cutter head body. Freezing portions are provided in the mounting holes, and the freezing portions are connected with driving devices configured to drive the freezing portions to extend from or retract

to the cutter head body. The freezing portions are connected to a freezing pipeline configured to supply freezing medium for the freezing portions.

[0009] A closed chamber is provided in the cutter head body, the mounting holes are arranged on a side wall of the closed chamber and penetrate through the side wall, and the freezing pipeline is provided in the closed chamber.

[0010] Preferably, the freezing portions are divided into multiple groups. The freezing portions in each group are sequentially connected by the freezing pipeline to form a freezing loop.

[0011] Preferably, each of the freezing portions is correspondingly provided with the driving devices.

[0012] Preferably, each of the driving devices is a hydraulic oil cylinder, the hydraulic oil cylinder is connected with a hydraulic pipeline, and the hydraulic pipeline is provided in the closed chamber.

[0013] Preferably, all the hydraulic oil cylinders are divided into multiple groups. Each of the hydraulic oil cylinders in each group has an oil supply port connected to a same main oil supply pipeline and an oil return port connected to a same main oil return pipeline.

[0014] Preferably, an outer peripheral freezing pipeline in an annular shape is provided on the outer periphery of the cutter head body, and a central axis of the outer peripheral freezing pipeline is parallel or collinear with a central axis of the cutter head body.

[0015] According to the present invention, the freezing portion has a pipe-in-pipe structure and is a semi-closed structure that opens toward the inside of the closed chamber, and an open end of the freezing portion is connected to the freezing pipeline.

[0016] Preferably, the cutter head body includes a central cylinder and spoke arms, and the spoke arms include main spoke arms and secondary spoke arms. All the main spoke arms are radially distributed around the central cylinder and connected to the central cylinder, the secondary spoke arms are connected between adjacent main spoke arms through ring beams, and the closed chambers are provided in the central cylinder and the spoke arms.

[0017] A tunnel boring machine includes a tunnel boring machine cutter head, and the tunnel boring machine cutter head is the tunnel boring machine cutter head described in any one of the above examples.

[0018] A method for replacing cutters applied to the tunnel boring machine cutter head described in any one of the above examples, includes:

driving, by the driving devices in the tunnel boring machine cutter head, the freezing portions in the tunnel boring machine cutter head to extend from the mounting holes in the tunnel boring machine cutter head and to extend into a heading face in front of the cutter head to a certain depth; and
providing the freezing medium to the freezing portions to freeze soil of the heading face into a freezing isolation layer.

[0019] The tunnel boring machine cutter head provided according to the present application includes the cutter head body. The cutter head body is provided with mounting holes which penetrate through the cutter head body. Freezing portions are provided in the mounting holes, and the freezing portions are connected with the driving devices configured to drive the freezing portions to extend from or retract to the cutter head body. The freezing portions are connected to the freezing pipeline configured to supply freezing medium for the freezing portions.

[0020] During the tunneling process, the freezing portions are retracted relative to the mounting holes to prevent the freezing portions from affecting the normal operation of the cutter head and avoid the wear and damage of the freezing portions brought by the cutter head during the rotating operation. When an operation of replacing the cutter is required, especially when the operation of replacing the cutter is required under harsh environmental conditions, the driving device drives the freezing portion to extend from the mounting hole and into the soil or slurry in the heading face in front of the cutter head to a certain depth, and the freezing medium is transported to the freezing portion. Through the freezing effect of the freezing medium in the freezing portion, the soil in the heading face is frozen into a freezing isolation layer with higher strength and stability, and the groundwater can be effectively prevented from infiltrating into the cutter head.

[0021] Since the tunnel boring machine cutter head is provided with retractable freezing portions, during operations of replacing or maintaining the cutter the freezing portions can freeze the soil at the front end of the heading face in an insertion points manner to form the freezing isolation layer, thereby improving the strength and stability of the soil of the heading face and providing a safe and convenient operating environment for the operations of replacing cutter. Besides, since the freezing portions extend from the cutter head body to perform freezing operations, the freezing of the cutter head steel structure can be reduced, and the ineffective operations of breaking the frozen soil of the soil sump can be reduced.

[0022] The tunnel boring machine including the tunnel boring machine cutter head provided by the present application can safely replace the cutters.

[0023] According to the cutter replacement method provided by the present application, the cutters can be safely replaced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] For more clearly illustrating embodiments of the present application or the technical solutions in the conventional technology, drawings referred to for describing the embodiments or the conventional technology will be briefly described hereinafter. The drawings in the following description are only examples of the present application, and for those skilled in the art, other drawings may be obtained based on the provided drawings without any creative efforts.

Figure 1 is a diagram showing the distribution of a freezing pipeline in a tunnel boring machine cutter head according to the present application;

Figure 2 is a diagram showing the distribution of a hydraulic pipeline in the tunnel boring machine cutter head according to the present application;

Figure 3 is a diagram showing the distribution of freezing portions in the tunnel boring machine cutter head according to the present application; and

Figure 4 is a diagram showing the covering areas of the freezing portions in the tunnel boring machine cutter head according to the present application.

[0025] Reference numerals in Figure 1 to 4:

1	main spoke arm,	2	ring beam,
3	secondary spoke arm,	4	central cylinder,
5	central cutter,	6	hobbing cutter,
7	serrated cutter,	8	slicer,
9	scraper,	10	closed chamber,
11	freezing portion,	12	freezing pipeline,
13	hydraulic oil cylinder,	14	hydraulic pipeline,
15	outer peripheral freezing pipeline.		

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0026] The technical solutions according to the embodiments of the present application will be described clearly and completely as follows in conjunction with the drawings in the embodiments of the present application. It is apparent that the described embodiments are only a part of the embodiments according to the present application, rather than all the embodiments. Based on the embodiments in the present application, all of other embodiments, made by those skilled in the art without any creative efforts, fall into the scope of the present application.

[0027] A core of the present application is to provide a tunnel boring machine cutter head which can ensure safe replacement of the cutter. Another core of the present application is to provide a tunnel boring machine including the tunnel boring machine cutter head, the cutter of which can be replaced safely. Yet another core of the present application is to provide a method for replacing the cutter applied to the tunnel boring machine cutter head, according to which the cutter can be safely replaced.

[0028] In a specific embodiment of the tunnel boring machine cutter head according to the present application, as shown in Figures 1 to 4, the tunnel boring machine cutter head includes a cutter head body. The cutter head body is provided with mounting holes which penetrate through the cutter head body. Freezing portions 11 are provided in the mounting holes, and each freezing portion 11 is connected with a driving device configured to drive the freezing portion 11 to extend from or retract to the cutter head body. The freezing portions 11 are connected to a freezing pipeline 12 configured to supply freezing medium for the freezing portions 11. Preferably, the freezing medium is a freezing liquid such as cold water.

[0029] During the tunneling process, the freezing portions 11 are retracted relative to the mounting holes to prevent the freezing portions 11 from affecting the normal operation of the cutter head and avoid the wear and damage of the freezing portions 11 brought by the cutter head during the rotating operation. When an operation of replacing the cutter is required, especially when the operation of replacing the cutter is required under harsh environmental conditions, the driving devices drive the freezing portion 11 to extend from the mounting hole and into the soil or slurry in the heading face in front of the cutter head to a certain depth, and the freezing medium is transported to the freezing portion 11. Through the freezing effect of the freezing medium in the freezing portion 11, the soil in the heading face is frozen into

a freezing isolation layer with higher strength and stability, and the groundwater can be effectively prevented from infiltrating into the cutter head.

[0030] It should be noted that, referring to Figure 4, the number of the freezing portions 11 may be set according to actual needs. Specifically, a freezing range of all freezing portions 11 should cover the entire heading face of the cutter head. The extension and retraction direction of the freezing portion 11 is preferably the tunneling direction along the axis of the cutter head. Apparently, the number and connection form of the freezing pipeline 12 may be set according to the structure of the cutter head or other needs.

[0031] In this embodiment, since the tunnel boring machine cutter head is provided with retractable freezing portions 11, during operations of replacing or maintaining the cutter, the freezing portions 11 can freeze the soil at the front end of the heading face in an insertion points manner to form a freezing isolation layer, thereby improving the strength and stability of the soil of the heading face and providing a safe and convenient operating environment for the operations of replacing cutter. Besides, since the freezing portions 11 extend from the cutter head body, the freezing of the cutter head steel structure can be reduced, and the ineffective operations of breaking the frozen soil of the soil sump can be reduced.

[0032] Further, a closed chamber 10 is provided in the cutter head body, the mounting holes are arranged on a side wall of the closed chamber and penetrate through the side wall, and the freezing pipeline 12 is provided in the closed chamber 10. During the tunneling process, since the freezing pipeline 12 is arranged in the closed chamber 10, unnecessary wear of the freezing pipeline 12 can be effectively avoided.

[0033] Further, all the freezing portions 11 may be divided into multiple groups. The freezing portions 11 in each group are sequentially connected by the freezing pipeline 12 to form a freezing loop, and one group of the freezing portions 11 corresponds to one freezing loop. In this embodiment, the arrangement of the freezing loop can reduce the overall space occupied by the freezing pipeline 12. The number of the freezing loops may be set according to actual conditions. For example, all freezing portions 11 may be connected in series via the freezing pipeline 12 to form a single freezing loop. In addition, the inlet and outlet of the freezing pipeline 12 may be provided at the center of the cutter head body.

[0034] On the basis of any one of the foregoing embodiments, each freezing portion 11 may be correspondingly provided with a driving device, so as to individually control the extension and retraction of each freezing portion 11 according to actual needs.

[0035] Further, the driving device may be a hydraulic oil cylinder 13, which is convenient for maintenance. The hydraulic oil cylinder 13 may be connected with a hydraulic pipeline 14 which is arranged in the closed chamber 10, so as to avoid damage to the hydraulic pipeline 14 during the movement of the cutter head. Apparently, the number and connection form of the hydraulic pipeline 14 may be set according to the structure of the cutter head or other needs.

[0036] Further, all the hydraulic oil cylinders 13 may be divided into multiple groups. Each of the hydraulic oil cylinders 13 in each group has an oil supply port connected to a same main oil supply pipeline and an oil return port connected to a same main oil return pipeline. Specifically, the main oil supply pipeline may be connected to the oil supply ports of the hydraulic oil cylinders 13 through branch oil supply hydraulic pipelines 14, and the main oil return pipeline is connected to the oil return ports of the hydraulic oil cylinders 13 through branch oil return hydraulic pipelines 14. For each group of hydraulic oil cylinders 13, the hydraulic oil can be diverged to the oil supply ports of each hydraulic oil cylinder 13 through a single input junction, and can be converged to the oil return ports of the hydraulic oil cylinders 13 at a single output junction, which is beneficial to reducing the number and space occupation of hydraulic pipelines.

[0037] Apparently, in addition to the hydraulic oil cylinder 13, the driving device may be configured as an air cylinder or other driving device.

[0038] On the basis of any one of the above embodiments, an outer peripheral freezing pipeline 15 in an annular shape may be provided on the outer periphery of the cutter head body, and a central axis of the outer peripheral freezing pipeline 15 is parallel or collinear with a central axis of the cutter head body. With the arrangement of the outer peripheral freezing pipeline 15, a closed freezing isolation ring can be formed after freezing the soil, which can further improve the strength of the soil after freezing, and the freezing isolation ring and the freezing region formed by the freezing portions 11 can together form a semi-closed freezing isolation enclosing region that wraps the front end of the cutter head, which effectively prevents the groundwater from infiltrating into the cutter head and the soil sump wrapped in this region and further provides a safe and convenient operating environment for the operations of replacing the cutters replacement operations.

[0039] On the basis of any one of the above embodiments, referring to Figure 3, the freezing portion 11 has a pipe-in-pipe structure, and is a semi-closed structure that opens toward the inside of the closed chamber 10, and an open end of the freezing portion 11 is connected to the freezing pipeline, which can prevent the leakage of the freezing medium from the freezing portion 11. According to the present invention, the freezing portion 11 includes multiple annular sleeves sleeved in sequence. One end of the innermost annular sleeve is closed and the other end is provided with an opening for the freezing medium to enter. All the other annular sleeves have two open ends, and each annular sleeve is hermetically connected to the adjacent outer annular sleeve, and each annular sleeve can extend or retract relative to the adjacent outer annular sleeve. By controlling the extension length of each annular sleeve, the extension depth of the freezing

portion 11 into the heading face can be controlled, which is more flexible to use and can be retracted when not in use to reduce space occupation.

[0040] On the basis of any one of the above embodiments, referring to Figures 1 and 2, the cutter head body includes a central cylinder 4 and spoke arms, and the spoke arms include main spoke arms 1 and secondary spoke arms 3. All the main spoke arms 1 are radially distributed around the central cylinder 4 and connected to the central cylinder 4, the secondary spoke arms 3 are connected between adjacent main spoke arms 1 through ring beams 2, and the connection strength between the main spoke arm 1 and the secondary spoke arm 3 is reliable. The closed chambers 10 are provided in the central cylinder 4 and the spoke arms. The spoke arms may be box girders, so that the freezing portions 11 can be placed on both the spoke arms and the central cylinder 4 to ensure the freezing area. The central cylinder 4 may be equipped with a central cutter 5, and the main spoke arm 1 and the secondary spoke arm 3 may be equipped with multiple replaceable hobbing cutters 6, serrated cutters 7, slicers 8, and scrapers 9.

[0041] The position of the driving device may be set according to actual needs. For example, the driving device may be arranged at the rear of the spoke arm, and the piston rod of the driving device extends into the closed chamber 10 of the spoke arm and is connected with the freezing portion 11.

[0042] In addition to the above tunnel boring machine cutter head, a tunnel boring machine is further provided according to the present application. The tunnel boring machine includes a tunnel boring machine cutter head, and the tunnel boring machine cutter head is the tunnel boring machine cutter head according to any one of the above embodiments. Accordingly, for the beneficial effects of the tunnel boring machine, reference may be made to the above embodiments. Reference may be made to the conventional technology for the structure of the other parts of the tunnel boring machine, which will not be described here.

[0043] Besides, a method for replacing cutters is further provided according to the present application, which is applied to the tunnel boring machine cutter head in any one of the above embodiments. The method for replacing the cutters specifically includes the following steps:

driving, by the driving device in the tunnel boring machine cutter head, the freezing portions in the tunnel boring machine cutter head to extend from the mounting holes in the tunnel boring machine cutter head and to extend into the heading face in front of the cutter head to a certain depth; and
providing the freezing medium to the freezing portions to freeze the soil of the heading face into a freezing isolation layer.

[0044] According to the method for replacing cutters provided by the present application, the cutters can be safely replaced.

[0045] The above embodiments are described in a progressive manner. Each of the embodiments mainly focuses on describing its differences from other embodiments, and references may be made among these embodiments with respect to the same or similar parts.

[0046] The tunnel boring machine, the tunnel boring machine cutter head, and the cutter replacement method for the tunnel boring machine cutter head provided by the present application have been introduced in detail hereinbefore. The principle and the embodiments of the present application are illustrated herein by specific examples. The above description of examples is only intended to help the understanding of the present application. It should be noted that, for those skilled in the art, many modifications and improvements may be made to the present application without departing from the principle of the present application, defined by the claims.

Claims

1. A tunnel boring machine cutter head comprising:

a cutter head body, wherein

the cutter head body is provided with mounting holes which penetrate through the cutter head body;

freezing portions (11) are provided in the mounting holes, the freezing portions (11) are connected with driving devices configured to drive the freezing portions (11) to extend from or retract to the cutter head body; and the freezing portions (11) are connected to a freezing pipeline (12) configured to supply freezing medium for the freezing portions (11),

wherein a chamber (10) is provided in the cutter head body, the mounting holes are arranged on a side wall of the chamber (10) and penetrate through the side wall, and the freezing pipeline (12) is provided in the chamber (10),

characterized in that, each of the freezing portions (11) has a pipe-in-pipe structure and is a semi-closed structure that opens toward an inside of the chamber (10), and an open end of the freezing portion (11) is

connected to the freezing pipeline (12),

the freezing portion (11) include multiple annular sleeves sleeved in sequence, one end of the innermost annular sleeve is closed and the other end is provided with an opening for the freezing medium to enter, all the other annular sleeves have two open ends, and each annular sleeve is hermetically connected to the adjacent outer annular sleeve, and each annular sleeve can extend or retract relative to the adjacent outer annular sleeve, by controlling the extension length of each annular sleeve, the extension depth of the freezing portion (11) into a heading face can be controlled.

2. The tunnel boring machine cutter head according to claim 1, wherein

the freezing portions (11) are divided into a plurality of groups; and
the freezing portions (11) in each group are sequentially connected by the freezing pipeline (12) to form a freezing loop.

3. The tunnel boring machine cutter head according to claim 2, wherein each of the freezing portions (11) is correspondingly provided with the driving devices.

4. The tunnel boring machine cutter head according to claim 2, wherein each of the driving devices is a hydraulic oil cylinder (13), the hydraulic oil cylinder (13) is connected with a hydraulic pipeline (14), and the hydraulic pipeline (14) is provided in the chamber (10).

5. The tunnel boring machine cutter head according to claim 4, wherein

the hydraulic oil cylinders (13) are divided into a plurality of groups; and
each of the hydraulic oil cylinders (13) in each group has an oil supply port connected to a same main oil supply pipeline and an oil return port connected to a same main oil return pipeline.

6. The tunnel boring machine cutter head according to any one of claims 1 to 5, wherein an outer peripheral freezing pipeline (15) in an annular shape is provided on an outer periphery of the cutter head body and a central axis of the outer peripheral freezing pipeline (15) is parallel or collinear with a central axis of the cutter head body.

7. The tunnel boring machine cutter head according to claim 6, wherein the cutter head body comprises a central cylinder (4) and spoke arms, and the spoke arms comprise main spoke arms (1) and secondary spoke arms (3); and all the main spoke arms (1) are radially distributed around the central cylinder (4) and connected to the central cylinder (4), the secondary spoke arms (3) are connected between adjacent main spoke arms (1) through ring beams (2), and the chambers (10) are provided in the central cylinder (4) and the spoke arms.

8. A tunnel boring machine comprising a tunnel boring machine cutter head, **characterized in that** the tunnel boring machine cutter head is the tunnel boring machine cutter head according to any one of claims 1 to 7.

9. A cutter replacement method for the tunnel boring machine cutter head according to any one of claims 1 to 7, **characterized in that** the method comprises:

driving, by the driving devices in the tunnel boring machine cutter head, the freezing portions (11) in the tunnel boring machine cutter head to extend from the mounting holes in the tunnel boring machine cutter head and to extend into a heading face in front of the cutter head to a certain depth;
providing freezing medium to the freezing portions (11) to freeze soil of the heading face into a freezing isolation layer; and
replacing cutters provided in the cutter head.

Patentansprüche

1. Tunnelbohrmaschine-Messerkopf, umfassend:

einen Messerkopfkörper, wobei
der Messerkopfkörper mit Montagelöchern versehen ist, die den Messerkopfkörper durchdringen;
Gefrierabschnitte (11) in den Montagelöchern bereitgestellt sind, wobei die Gefrierabschnitte (11) mit Antriebs-

vorrichtungen verbunden sind, die so konfiguriert sind, dass sie die Gefrierabschnitte (11) antreiben, um sich aus dem Messerkopfkörper auszudehnen oder sich in diesen zurückzuziehen; und die Gefrierabschnitte (11) mit einer Gefrierleitung (12) verbunden sind, die so konfiguriert ist, dass sie Gefriermedium für die Gefrierabschnitte (11) liefert,

wobei eine Kammer (10) in dem Messerkopfkörper bereitgestellt ist, die Montagelöcher an einer Seitenwand der Kammer (10) angeordnet sind und die Seitenwand durchdringen, und die Gefrierleitung (12) in der Kammer (10) bereitgestellt ist,

dadurch gekennzeichnet, dass jeder der Gefrierabschnitte (11) eine Rohr-in-Rohr-Struktur aufweist und eine halbgeschlossene Struktur ist, die sich zu einer Innenseite der Kammer (10) hin öffnet, und ein offenes Ende des Gefrierabschnitts (11) mit der Gefrierleitung (12) verbunden ist, der Gefrierabschnitt (11) mehrere ringförmige Hülsen einschließt, die in Folge mit Hülsen versehen sind, ein Ende der innersten ringförmigen Hülse geschlossen ist und das andere Ende mit einer Öffnung für den Eintritt des Gefriermediums versehen ist, alle anderen ringförmigen Hülsen zwei offene Enden aufweisen und jede ringförmige Hülse hermetisch mit der benachbarten äußeren ringförmigen Hülse verbunden ist und sich jede ringförmige Hülse relativ zu der benachbarten äußeren ringförmigen Hülse ausdehnen oder sich in sie zurückziehen kann, indem die Ausdehnungslänge jeder ringförmigen Hülse gesteuert wird, die Ausdehnungstiefe des Gefrierabschnitts (11) in eine Ortsbrust hinein gesteuert werden kann.

2. Tunnelbohrmaschine-Messerkopf nach Anspruch 1, wobei

die Gefrierabschnitte (11) in eine Vielzahl von Gruppen unterteilt sind; und die Gefrierabschnitte (11) in jeder Gruppe nacheinander durch die Gefrierleitung (12) verbunden sind, um eine Gefrierschleife zu bilden.

3. Tunnelbohrmaschine-Messerkopf nach Anspruch 2, wobei jeder der Gefrierabschnitte (11) entsprechend mit den Antriebsvorrichtungen versehen ist.

4. Tunnelbohrmaschine-Messerkopf nach Anspruch 2, wobei jede der Antriebsvorrichtungen ein Hydraulikölzylinder (13) ist, der Hydraulikölzylinder (13) mit einer Hydraulikleitung (14) verbunden ist und die Hydraulikleitung (14) in der Kammer (10) bereitgestellt ist.

5. Tunnelbohrmaschine-Messerkopf nach Anspruch 4, wobei

die Hydraulikölzylinder (13) in eine Vielzahl von Gruppen unterteilt sind; und jeder der Hydraulikölzylinder (13) in jeder Gruppe einen Ölzufuhranschluss, der mit derselben Hauptölzufuhrleitung verbunden ist, und einen Ölrücklaufanschluss aufweist, der mit derselben Hauptölrücklaufleitung verbunden ist.

6. Tunnelbohrmaschine-Messerkopf nach einem der Ansprüche 1 bis 5, wobei eine äußere periphere Gefrierleitung (15) in Ringform an einer äußeren Peripherie des Messerkopfkörpers bereitgestellt ist und eine Mittelachse der äußeren peripheren Gefrierleitung (15) parallel oder kollinear zu einer Mittelachse des Messerkopfkörpers verläuft.

7. Tunnelbohrmaschine-Messerkopf nach Anspruch 6, wobei der Messerkopfkörper einen Zentralzylinder (4) und Speichenarme umfasst, und die Speichenarme Hauptspeichenarme (1) und Nebenspeichenarme (3) umfassen; und

alle Hauptspeichenarme (1) sind radial um den Zentralzylinder (4) verteilt und mit dem Zentralzylinder (4) verbunden, die Nebenspeichenarme (3) sind zwischen benachbarten Hauptspeichenarmen (1) durch Ringbalken (2) verbunden, und die Kammern (10) sind im Zentralzylinder (4) und den Speichenarmen bereitgestellt.

8. Tunnelbohrmaschine, umfassend einen Tunnelbohrmaschine-Messerkopf, **dadurch gekennzeichnet, dass** es sich beim Tunnelbohrmaschine-Messerkopf um den Tunnelbohrmaschine-Messerkopf nach einem der Ansprüche 1 bis 7 handelt.

9. Messeraustauschverfahren für den Tunnelbohrmaschine-Messerkopf nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass** das Verfahren umfasst:

Antreiben, durch die Antriebsvorrichtungen im Tunnelbohrmaschine-Messerkopf, der Gefrierabschnitte (11) im

Tunnelbohrmaschine-Messerkopf, so dass sie sich von den Montagelöchern in den Tunnelbohrmaschine-Messerkopf ausdehnen und sich bis zu einer bestimmten Tiefe in eine Ortsbrust hinein vor dem Messerkopf ausdehnen;
 Zuführen von Gefriermedium zu den Gefrierabschnitten (11), um den Boden der Ortsbrust zu einer Gefrierisolationsschicht zu gefrieren; und
 Austauschen der im Messerkopf bereitgestellten Messer.

Revendications

1. Tête de coupe pour tunnelier comprenant :

un corps de tête de coupe, dans laquelle
 le corps de tête de coupe est pourvu de trous de montage qui traversent le corps de tête de coupe ;
 des parties de congélation (11) sont prévues dans les trous de montage, les parties de congélation (11) sont reliées à des dispositifs d'entraînement configurés pour entraîner les parties de congélation (11) afin qu'elles s'étendent ou se rétractent par rapport au corps de tête de coupe ; et
 les parties de congélation (11) sont reliées à une canalisation de congélation (12) configurée pour fournir un agent de congélation aux parties de congélation (11),
 dans laquelle une chambre (10) est prévue dans le corps de tête de coupe, les trous de montage sont disposés sur une paroi latérale de la chambre (10) et traversent la paroi latérale, et la conduite de congélation (12) est prévue dans la chambre (10),
caractérisée en ce que, chacune des parties de congélation (11) a une structure tube dans tube et est une structure semi-fermée qui s'ouvre vers l'intérieur de la chambre (10), et une extrémité ouverte de la partie de congélation (11) est reliée à la canalisation de congélation (12),
 la partie de congélation (11) comporte plusieurs manchons annulaires emmanchés en séquence, une extrémité du manchon annulaire le plus interne est fermée et l'autre extrémité est pourvue d'une ouverture pour faire entrer l'agent de congélation, tous les autres manchons annulaires ont deux extrémités ouvertes, et chaque manchon annulaire est hermétiquement relié au manchon annulaire externe adjacent, et chaque manchon annulaire peut s'étendre ou se rétracter par rapport au manchon annulaire externe adjacent, en contrôlant la longueur d'extension de chaque manchon annulaire, la profondeur d'extension de la partie de congélation (11) dans une face frontale peut être contrôlée.

2. Tête de coupe pour tunnelier selon la revendication 1, dans laquelle

les parties de congélation (11) sont divisées une pluralité de groupes ; et
 les parties de congélation (11) de chaque groupe sont reliées séquentiellement par la canalisation de congélation (12) pour former une boucle de congélation.

3. Tête de coupe pour tunnelier selon la revendication 2, dans laquelle chacune des parties de congélation (11) est pourvue de dispositifs d'entraînement correspondants.

4. Tête de coupe pour tunnelier selon la revendication 2, dans laquelle chacun des dispositifs d'entraînement est un cylindre d'huile hydraulique (13), le cylindre d'huile hydraulique (13) est relié à une canalisation hydraulique (14), et la canalisation hydraulique (14) est prévue dans la chambre (10).

5. Tête de coupe pour tunnelier selon la revendication 4, dans laquelle

les cylindres d'huile hydraulique (13) sont divisés une pluralité de groupes ; et
 chacun des cylindres d'huile hydraulique (13) de chaque groupe a un orifice d'alimentation en huile relié à une même canalisation principale d'alimentation en huile et un orifice de retour d'huile relié à une même canalisation principale de retour d'huile.

6. Tête de coupe pour tunnelier selon l'une quelconque des revendications 1 à 5, dans laquelle une conduite de congélation périphérique externe (15) de forme annulaire est prévue sur une périphérie externe du corps de tête de coupe et un axe central de la conduite de congélation périphérique externe (15) est parallèle ou colinéaire à un axe central du corps de tête de coupe.

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7. Tête de coupe pour tunnelier selon la revendication 6, dans laquelle le corps de tête de coupe comprend un cylindre central (4) et des bras de rayon, et les bras de rayon comprennent des bras de rayon principaux (1) et des bras de rayon secondaires (3) ; et
tous les bras de rayons principaux (1) sont répartis radialement autour du cylindre central (4) et reliés au cylindre central (4), les bras de rayons secondaires (3) sont reliés entre des bras de rayons principaux (1) adjacents à travers des poutres annulaires (2), et les chambres (10) sont prévues dans le cylindre central (4) et les bras de rayon.

8. Tunnelier comprenant une tête de coupe de tunnelier, **caractérisé en ce que** la tête de coupe de tunnelier est la tête de coupe de tunnelier selon l'une quelconque des revendications 1 à 7.

9. Procédé de remplacement de la tête de coupe de tunnelier selon l'une quelconque des revendications 1 à 7, **caractérisé en ce que** le procédé comprend :

l'entraînement, par les dispositifs d'entraînement dans la tête de coupe de tunnelier, des parties de congélation (11) dans la tête de coupe de tunnelier afin qu'elles s'étendent des trous de montage dans la tête de coupe de tunnelier et qu'elles s'étendent dans une face frontale devant la tête de coupe jusqu'à une certaine profondeur ; la fourniture d'un agent de congélation aux parties de congélation (11) pour congeler le sol de la face frontale en une couche d'isolation de la congélation ; et
le remplacement des fraises prévues dans la tête de coupe.

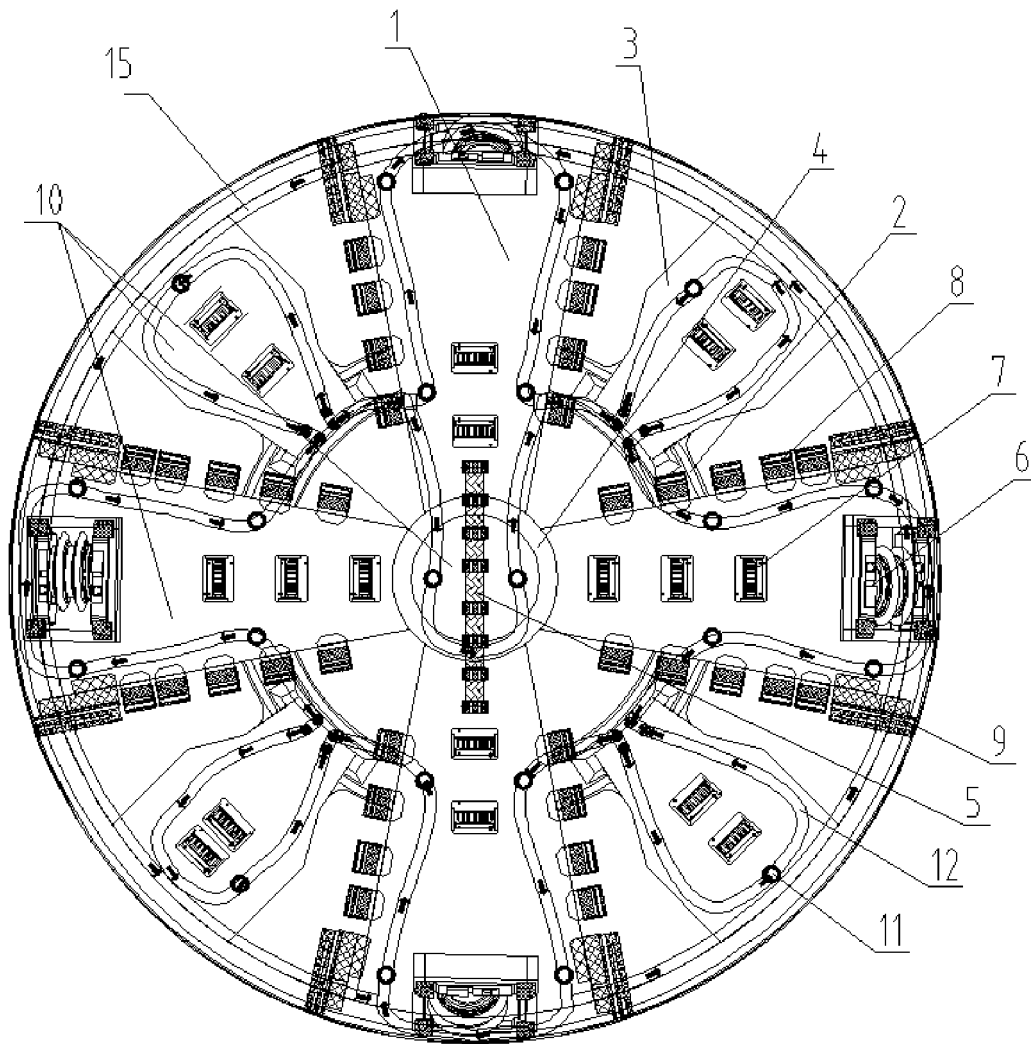


Figure 1

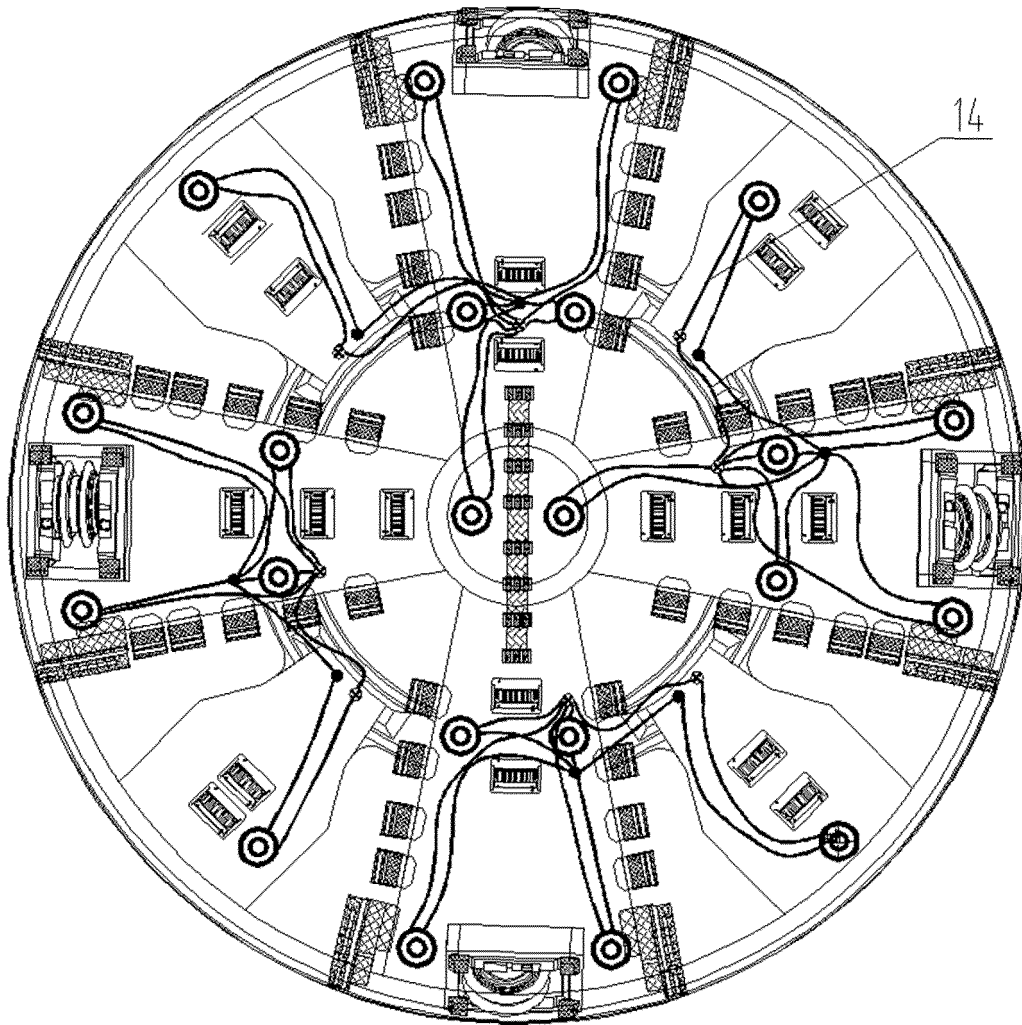


Figure 2

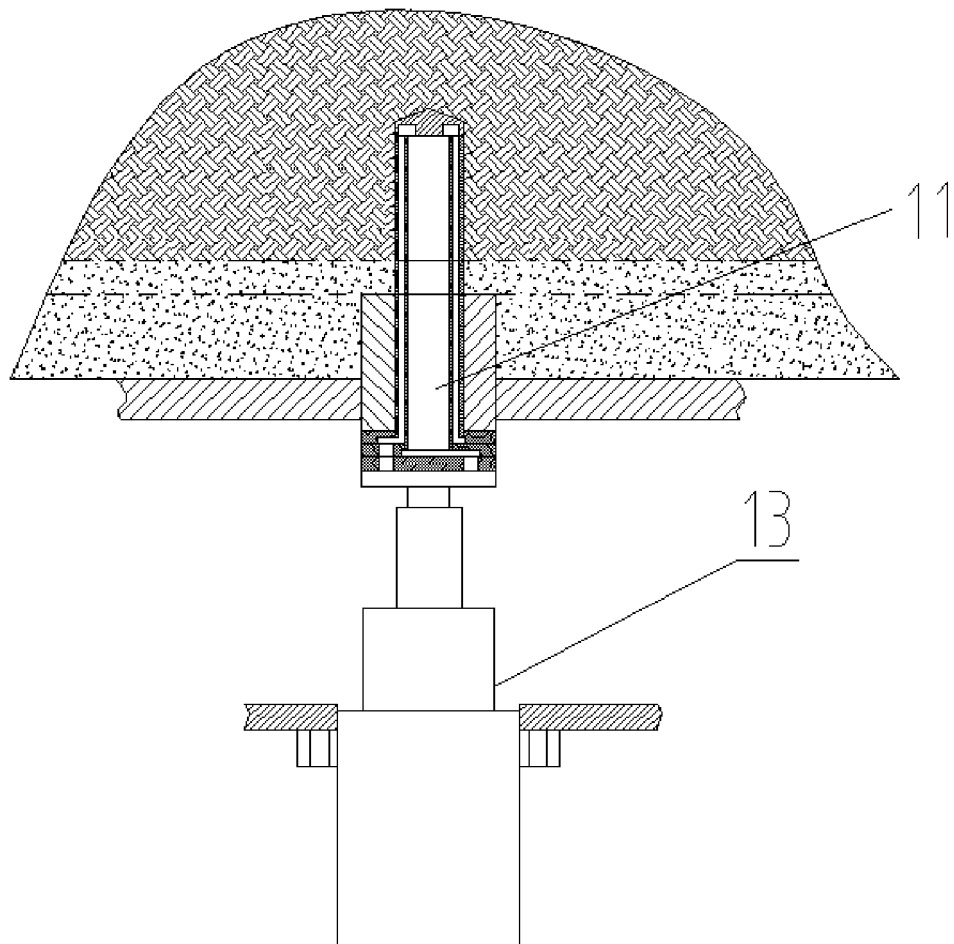


Figure 3

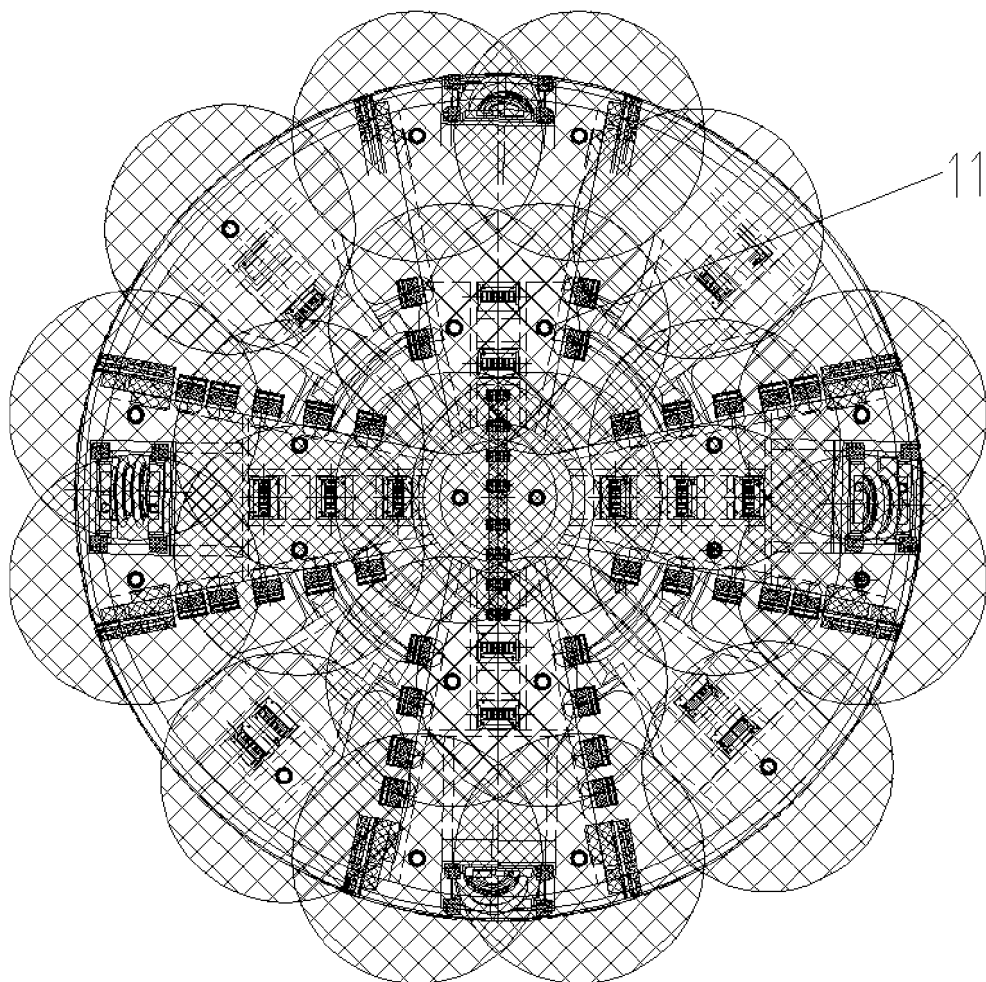


Figure 4

REFERENCES CITED IN THE DESCRIPTION

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